Syclone Portable Gamma-Ray Spectrometer

User Manual

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Revision: 4

Revision History			
Revision	**Date**	**ECO**	**Description**
1	June 25, 2012	N/A	Released
2	August 30,2012	635	Add minor changes
3	November 22,2012	655	Add minor changes/Remove RadView software description
4	April 2, 2013	685	Minor changes

Product Manual - Disclaimers:

Due to our efforts to continuously improve this product; specifications, dimensions, operating features and procedures described in this manual are subject to frequent changes. The printed version of this manual reflects only the configuration current at the time of printing. The most current version of the manual is provided in electronic format on the Product Support CD supplied with the instrument. Please refer to the electronic version of the manual for the most accurate interpretation. Contact RadComm Radiation Detection Systems at www.radcommsystems.com

CONFIDENTIAL DISCLOSURE

USERS ARE HEREBY NOTIFIED THAT THIS MANUAL CONTAINS TECHNICAL INFORMATION OF A PROPRIETARY NATURE. THIS INFORMATION IS NECESSARY FOR TECHNICALLY KNOWLEDGEABLE USERS TO UNDERSTAND SYSTEM OPERATION AND TO SATISFY THEMSELVES THAT THE SYSTEM IS PERFORMING CORRECTLY.

RADCOMM ACCEPTS THAT IT IS THE RIGHT OF SUCH USERS TO BE PRIVY TO THIS INFORMATION. HOWEVER THIS DOCUMENTATION IS PROVIDED SOLELY FOR THE BENEFIT OF OWNERS OF THE SYCLONE PORTABLE DETECTOR AND DISSEMINATION OF THE DETAILED TECHNICAL INFORMATION PROVIDED MAY BE CONSIDERED AS LEGALLY CONTRAVENING THE NORMAL SUPPLIER/CUSTOMER RELATIONSHIP.

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1.0 GENERAL SYSTEM DESCRIPTION

The **Syclone Gamma-Ray Portable Spectrometer** - represents a major breakthrough in the field of radiation monitoring, offering the user not only the ability to search for and locate radioactive material but also to automatically identify the radioactive nuclides present. This capability in a fully portable hand-held unit will permit its use in a wide variety of applications including:

- Hazard identification and risk assessment
- Inspection of incoming and outgoing material for radioactive contamination
- Inspection of radioactive gauges for leaks
- SEARCH of waste sites for radioactive material
- Employee exposure rate and dose monitoring
- Radioactive source monitoring
- Government inspection for material compliance
- Identification of unknown radioactive material
- Regulatory control of radioactive material
- Classification of radioactive material for a wide variety of users

1.1 SYCLONE HARDWARE

Syclone Portable Gamma-Ray Spectrometer – is a highly sensitive and responsive unit which utilizes the highest quality Thallium doped NaI crystal, combined with an integral high signal to noise ratio PMT, state-of-the-art electronics and embedded microcontroller firmware.

The Syclone portable radiation detector has been designed to detect, find and identify specific and/or multiple isotopes from radioactive materials (even weak gamma sources) hidden from view. The unit has adjustable sensitivity levels and automatically adjusts to the background radiation, which helps prevent nuisance alarms.

The mechanical assembly of the Syclone is robust and durable, designed to be used in field applications where harsh environment are associated.

1.2 SOFTWARE

This manual describes the current firmware release, and all information regarding system (PC) software.

1. **Syclone Operating System (Firmware)**

   The Syclone operating system utilizes sensible easy to read and follow menus. The multi-position joystick and large LCD backlit display provides a user friendly method to navigate through menu selections. Detailed spectral information is clearly and precisely displayed to provide knowledgeable users with the capability to visually identify peaks in the histogram. Various on-screen messages assist the user when immediate attention is required for issues such as preset timing, high radiation levels, alarm settings and Warning messages.

2. **Remote SYCLONE PC Spectral Analysis and Data Storage Software**

   The Syclone is equipped with a large internal memory, to store large amounts of data which is stored by record number, date and time.

   Stored data, such as spectral and dose rate information can be easily downloaded to a PC through mini USB or Bluetooth. The downloaded data can be displayed and managed with

the powerful SYCLONE PC Software. Primary features such as the selection and highlighting of R.O.I. details and Zoom In/Out of the gamma energy histogram can be easily performed. The SYCLONE PC Software has all the necessary features that will meet the needs of virtually any user.

1.3 BASIC SYSTEM OPERATION

The Syclone is delivered fully charged and ready to operate. The user chooses the mode of operation **MANUAL**, **SIMPLIFIED** or **AUTOMATIC**. This is performed by user selection, when the cover page appears the user holds down the joystick to see the Mode selection screen. Most operators will use either the **SIMPLIFIED** or **AUTOMATIC** mode(s) which are designed to allow for fast and easy inspection of areas, containers or vehicles that may contain radioactive materials, or to verify or separate radioactive materials that have triggered an alarm from a large scale radioactive detector system. The **SIMPLIFIED** Mode is similar to the **AUTOMATIC** Mode, but when a source is found it switches to **IDENTIFY** automatically (the spectra is stored for further analysis, but the Dose Rate is not saved).

Notes:

- When using the Syclone in potentially dangerous situations a maximum Dose Rate or CPS Rate can be preset by the customers' parameters. If the dose rate or cps rises above the set level it triggers an automatic acoustic alarm warning the user to find protection.
- The Syclone when used in Simplified mode will end the identification routine when the first isotope is identified. It is strongly recommended that an additional 30s(→ 30S) be selected from the display to ensure the proper isotope identification.

SYCLONE MODES of Operation:

AUTOMATIC MODE (See Appendix D for Quick Start):

Restricted to **SEARCH** and **IDENTIFY** functions only, all other functions are disabled to simplify system use for non-technical personnel.

- The Syclone uses a radioactive check source (Cs-137) to maintain the systems' stability (when the unit requests stabilization, the user places the Cs-137 check source on the central mark at the face of the unit, and follows the screen messages).
- The Syclone contains a state-of-the-art microprocessor and internal circuitry designed to automatically set the lowest achievable alarm level and to continuously monitor system operation in order to maintain consistent optimum performance.
- Upon the initial self-test the Syclone will begin operating as soon as it is turned on.
- The Syclone can only use the manufacturers' provided rechargeable lithium batteries. These batteries provide around 7 hrs of continuous service.
- The Syclone displays the battery condition in the top right corner on the LCD. A **FULL** charge is indicated by all three squares filled with **GREEN**, as the charge reduces to one square, it changes colour to yellow. When the batteries fall below a certain level, an audio warning occurs and the Battery ICON becomes **RED** and flashes. The user has approximately 30 minutes of measuring time left in the battery at this time. When there is no longer enough power to allow measuring, the Syclone turns **OFF**.
- The functions **SEARCH** and **IDENTIFY** are available to the Automatic Mode, while all other functions are not accessible to the operator. (The Automatic Mode is suitable for operators who need only to detect the presence and identification of a radioactive material).

- The Screens SEARCH, IDENTIFY and NUCLIDE IDENTIFY have a navigation menu displayed (see Chapter 3.0) at the bottom of the screen to help the operator choose joystick control functions.
- When the operation is complete and the Syclone is no longer required, the battery power supply is plugged into the unit. This allows the internal battery charger to charge the battery.
- Connecting the Syclone unit to the PC with the USB Cable will allow user to start the data download.

SIMPLIFIED MODE – The Simplified Mode is easy to use and is very suitable for rapid **SEARCH** and detection of Gamma Ray emitting radioactive sources in suspect vehicles and containers. The unit will store any detected spectra for further analysis and can download the samples to the PC using the supplied USB cable. See Chapter 4.0 for more information.

Note: This mode is very useful when inspecting a volume of containers and/or vehicles such as at a border crossing for radioactive materials.

MANUAL MODE – unrestricted system operation: (This mode is Not documented in this manual) Please refer to the complete **Syclone Service Manual** for details.

Note: This mode is used by technicians to setup the Syclone to customers' parameters.

First time operation of the Syclone, refer to **Appendix D** for a guide to the Automatic Mode Quick Start.

1.4 NORMAL OPERATION (PRIMARY MONITORING FUNCTIONS)

The Syclone may be operated in two **Primary** radiation monitoring functions:

a) **SEARCH**

In this function, the Syclone acts as a RADIOMETER displaying the current COUNT RATE in counts/sec. A variable-tone **AUDIO** will indicate radiation intensity with an automatic audio meter or user adjusted alarm level. The display will show an increasing count/second (cps) numeric radiation level. This function is typically used to search for radioactive material or to carry out Total-Count Search.

The SEARCH function displays the current DOSE RATE (in selectable units and quantities) as well as ACCUMULATED DOSE from the time the function was enabled. The dose meter is used to determine the relative hazard level and to assess handling requirements of a radioactive material. Dose Search of an area can also be carried out in SEARCH.

b) **IDENTIFY** – (Nuclide Identification)

In this function, the Syclone accumulates spectral data from a sample and analyses the spectrum in terms of emitted energy level and net count contribution. The nuclides responsible for producing the spectrum are identified by comparison to a nuclide library. This essential information can then be used to determine risk assessment.

1.5 SYSTEM FEATURES

a) INSTRUMENT BODY - The instrument body consists of two primary parts, the lower case and top panel. The combination of the two parts provides a high degree of system strength, suitable for field operations where mechanical abuse may be unavoidable.

b) DETECTOR –

i. **Crystal Detector -** The 1.5" (38mm) x 2" (51mm) Thallium doped sodium-iodide (NaI) crystal is specially designed for rugged environments.

ii. **GM** – the rugged Geiger-Muller tube is mounted just behind the instrument front face and is used to extend the Dose Rate range to 10 R/hr (100 mSv/hr) for special applications.

iii. **Neutron Detector** - **^{3}He** – this is a helium filled neutron counter.

c) EFFECTIVE CENTER – The optimum sensing area for the Sodium Iodide (NaI) detector is the area represented by the central mark located on the front of the blue Syclone case.

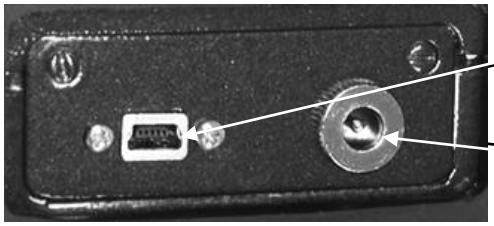
d) HANDLE – The handle was carefully designed to allow for a variety of grips, it also gives the unit a measure of strength and provides a comfortable balance which affords the operator hours of stress free usage.

e) JOYSTICK - The Syclone has only one operating control - the four position joystick on the handle. All system functions are controlled by the **JOYSTICK** that permits very easy instrument functions **(*EVEN WHILE WEARING GLOVES IN A BIOHAZARD SUIT)*.** The JOYSTICK is a specially designed switch with four actions – UP, DOWN, LEFT, and RIGHT. The JOYSTICK and use of menu driven functions makes the Syclone very easy to operate and avoids the necessity of "memorizing" complex sequences of action.

Note: A joystick Navigation Menu is available at the bottom of each screen in Automatic Mode (see **Appendix D**).

f) DISPLAY - A LCD is used for the Syclone to permit a full range of alphanumeric and graphic display capabilities. This LCD gives excellent contrast in high light conditions.

g) REAR CONNECTIONS – The Syclone has PC and Battery Charger connections mounted on the rear of the unit.



To connect to the PC and transfer data using the mini USB cable.

To connect to the supplied power supply cable.

h) BATTERIES - The Syclone requires manufacturers' supplied lithium batteries.

While rechargeable batteries are shipped fully charged, they will self-discharge with time when not in use. It is important to condition new batteries, whether received with the system or purchased separately. Conditioning is achieved by first totally discharging the batteries in the **SYCLONE** unit and then fully charging them for at least 4 hours.

Note: To get reliable performance and full capacity out of the batteries throughout their life, it is important to let them fully discharge and then fully re-charge for 4 hours at least once every two months. This will assure that the batteries provide around 7 hours of operation.

i) BATTERY-CHARGER – the battery charger is an integral part of the unit and requires the supplied power supply, which plugs into a normal wall receptacle using house current.

j) CHECK SOURCE – The Syclone uses a 0.25 µCi Cs-137 check source, which will stabilize the unit under 3 mins.

Note: There is a central mark on the front of the case which represents the effective center of the NaI detector. Place the supplied source at this spot when the unit requests stabilization, and follow the screen messages.

k) SYSTEM SUPPORT SOFTWARE - The **SYCLONE PC** software is provided with the Syclone unit on a CD-ROM. This is a Windows based program that operates under Windows NT, 2000, XP and System 7. The program and its' operation is described in **Appendix A**. It provides data downloading, data display, custom library uploading, spectrum display analysis

and various other features.

l) HARD SHELL TRANSPORTATION CASE - The system is supplied with a hard shell carrying case for easy transportation of the Syclone.

m) USER MANUAL - This user manual is supplied with the instrument.

2.0 DETAILED OPERATION GUIDE

This section offers a detailed guide to system operation. The "**AUTOMATIC**" (same as simplified) mode of operation is described in **Chapter 3.0**.

2.1 JOYSTICK

JOYSTICK ACTIONS

The Syclone is equipped with a four position JOYSTICK on the instrument handle, referred to in this manual as the JOYSTICK and this is the ONLY control on the instrument. The great advantage of this single button control is that besides being very easy to use it also permits full operation EVEN WHEN WEARING GLOVES – a definite advantage in many applications where protective clothing is required.

Various Joystick actions are permitted depending on the application:

CLICK UP/DOWN - a **SHORT** (up to 0.5 sec) push (CLICK) of the JOYSTICK **UP** (away from the user) or **DOWN** (towards the user) is used to scroll through the system menus.

ENTER - holding the JOYSTICK **DOWN** (toward the ON position on the joystick label) for about **ONE SECOND** (in the manual referred to as **ENTER**) is used to activate the selection highlighted on the display.

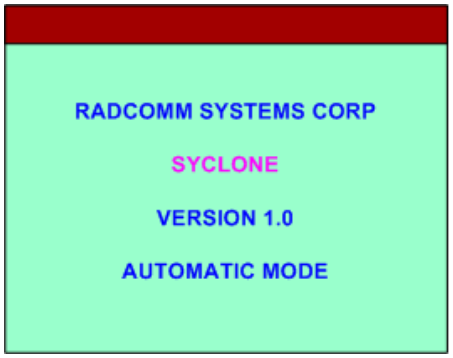
CLICK LEFT/RIGHT – SHORT (up to 0.5 sec) click used in some menus to change parameters.

2.2 POWER AND STARTUP FUNCTIONS

a) POWER ON

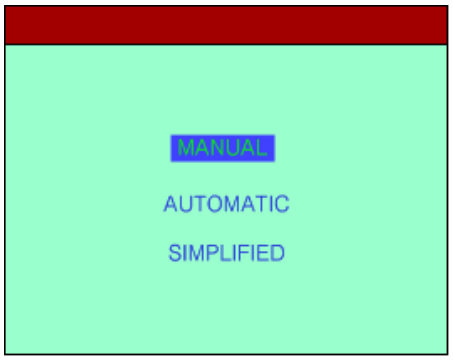
System Startup Screen (Cover Screen)

After approx. 2 seconds the display will be replaced by the normal startup screen as shown. The normal startup display remains on the screen for a few seconds.



b) MODE SELECTION (See Section 2.3 for more information)

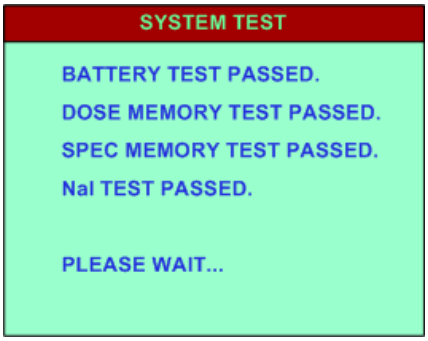
The Syclone is delivered fully powered and in the **MANUAL Mode**, so that the customers' technician can setup parameters specific to their usage. To change the Mode setting, startup the unit and hold down the joystick when the cover page appears, the mode selection screen will then appear and the user can use the joystick to choose from **MANUAL**, **AUTOMATIC**, or **SIMPLIFIED**



MODE. The Syclone is ready to be used for the selected mode by the operator or technician.

c) Initialization and Testing

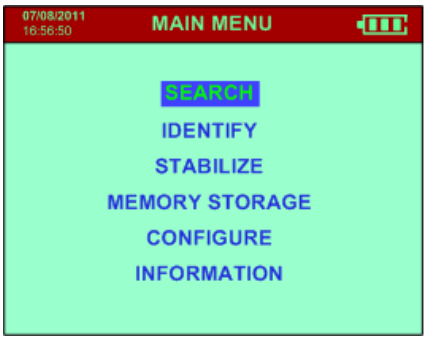
To switch the unit **ON**, **CLICK DOWN** (towards the user) the joystick. The display will come on and System Initialization will proceed for a few seconds. The unit is carrying out internal testing to verify that components are functioning correctly. If errors are found, an audio beep will be heard.



d) MAIN MENU

After the initial start-up screen, the Syclone Main Menu appears. The user may scroll through the menu items by a short click **UP** or click **DOWN**. Reverse "highlighting" shows the current menu item selected.

Menu items are selected by highlighting the desired item and clicking **ENTER** to activate the selection. When the system is turned ON, user can use the system after 2 – minute warm up time. For the best performance, please let the system warm up for 15 to 20 minutes.



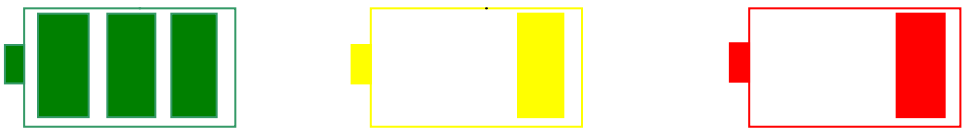
e) POWER OFF - MANUAL

To power the unit OFF, CLICK **UP** (away from the user) and hold for approx. **4** seconds. The display (see Figure) shows the seconds counting down; **3, 2, 1**. After this countdown the unit powers OFF. At any time during the countdown, releasing the JOYSTICK will cancel the power OFF.

f) LOW BATTERY WARNINGS

The Battery ICON at the top right of the display is used to provide the user with an idea of the current battery status.

To provide some level of warning of imminent battery life - if the batteries fall below a certain level then an audio warning occurs and the Battery ICON flashes for immediate attention. The user has approximately 30 minutes of measuring time left in the battery at this time. When there is no longer enough power to allow measuring, the Syclone turns **OFF**.



Full Charge 1/3 Charge Low Battery Warning (Flashing)

Figure 2-2

2.3 SWITCHING SYCLONE OPERATIONAL MODES

The unit can be set to either the **AUTOMATIC, SIMPLIFIED** or **MANUAL Mode(s)** at any time. Selection between modes is performed from the Mode selection screen. The User makes the selection with the joystick, when the cover page appears the User holds down the joystick to see the Mode selection screen. The User then chooses between MANUAL,

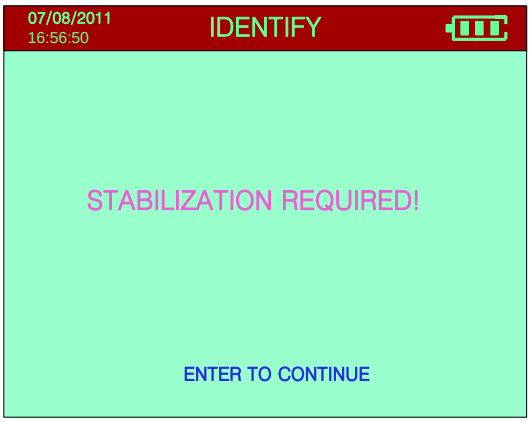
AUTOMATIC or SIMPLIFIED MODE with the joystick.

AUTOMATIC MODE: This mode was designed to allow for fast and easy inspection of areas, containers or vehicles that may contain radioactive materials. This mode provides, **SEARCH**, and **Identify** capabilities, which allows the User to collect large amounts of data which is then transferred to the PC for analysis. This mode is also used by scientists to quickly identify and locate potentially hazardous radioactive sources for immediate investigation.

SIMPLIFIED MODE – The Simplified Mode is easy to use and is very suitable for rapid **SEARCH** and detection of Gamma Ray emitting radioactive sources in suspect vehicles and containers. The unit will store any detected spectra for further analysis, the user can download the samples to the PC using the supplied USB cable. See Chapter 4.0 for more information.

MANUAL MODE: This Mode is available to qualified technicians in order to setup the equipment and change the operating parameter(s) to suit the users' application(s). This mode is also useful to the scientist to acquire data, identify and analyze conditions in the field. For further information refer to the **Syclone Service Manual**.

2.5 STABILIZATION



When any spectrometer is turned ON, the internal electronic components exhibit some level of warm-up drift with time, which may be exacerbated by changes in the ambient temperature Sodium Iodide (NaI) crystals typically exhibit a +/- 15% change in scintillation light output over the -10 to +50^{o}C temperature range. If not corrected this drift could seriously affect data analysis. For this reason, the Syclone incorporates a procedure known as STABILIZATION to remove these effects. Stabilization automatically "fine-tunes" the system to adjust the internal system gain and align the spectrometer correctly.

The User can activate **STABILIZE** by pressing **ENTER TO CONTINUE**, Stabilization can also be started from the MAIN MENU of Manual Mode. Carry out the stabilization function using the external Cesium source (Cs-137 supplied with unit).

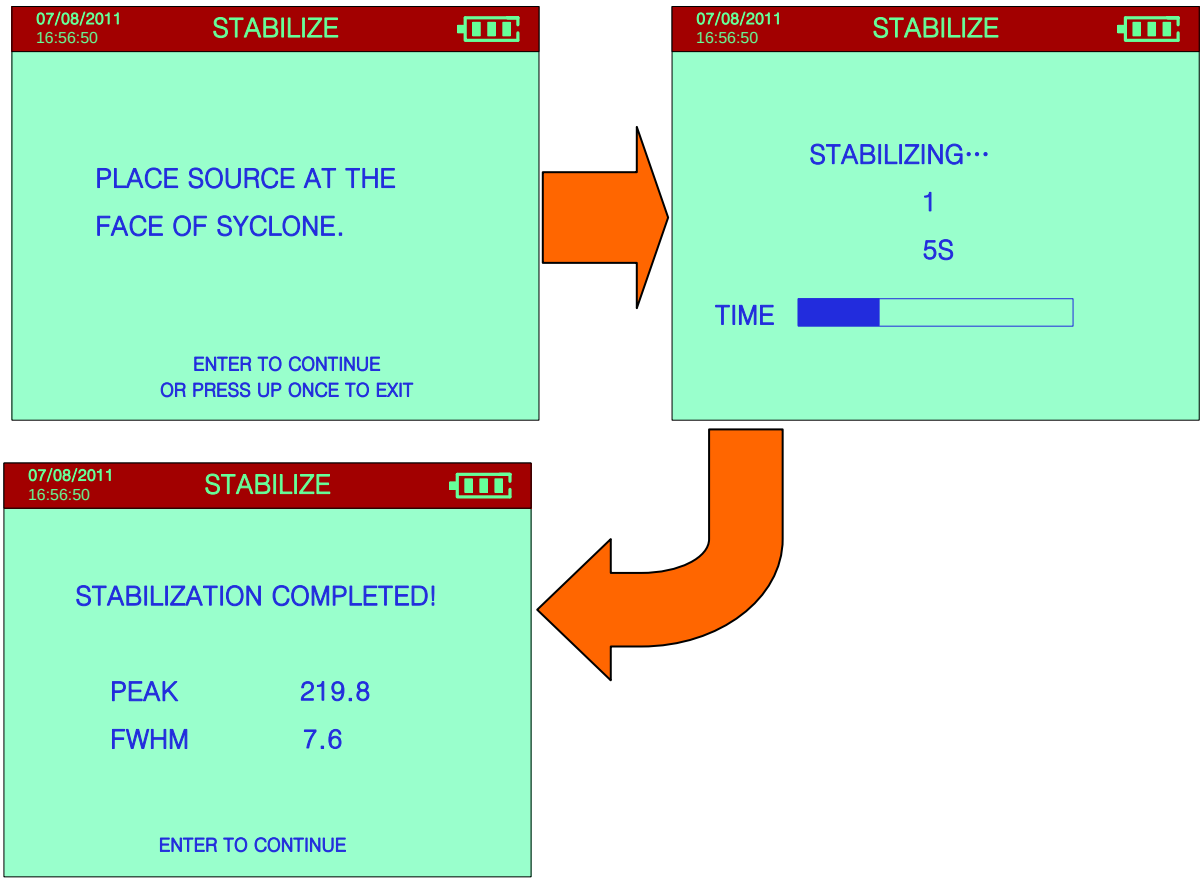
The User can select from "**Configuration**" – "**Stabilization**" menu, there are several options to stabilize the Syclone. These are: '**12 hours**', **'24 hours**', "**AUTO**" and "**OFF**".

The options '**12**' and '**24 hours**' adjust the time intervals when the Syclone will notify the user to re-stabilize the unit. '**AUTO**' is an option to avoid frequent Cs-137 source stabilization for NaI detector temperature interval between 14^{o}C to 34^{o}C. If the detector temperature falls above or below the set parameter, the message "**Stabilization required**" will appear on the display. If the user does not need nuclide ID, but still wants to accumulate the spectra he or she can turn stabilization to '**OFF**'.

IT IS EXTREMELY IMPORTANT THAT STABILIZATION BE CARRIED OUT AS REQUIRED.

AFTER LOADING DEFAULT PARAMETERS - THE ACT OF STABILIZATION SETS ALL THE SYSTEM COMPUTATIONAL REQUIREMENTS FOR CARRYING OUT THE IDENTIFY FUNCTION. WITHOUT THIS STABILIZATION SERIOUS DATA ANALYSIS ERRORS WILL OCCUR!

SEE THE FOLLOWING SECTIONS FOR DETAILS ON OTHER FUNCTIONS.



Follow the instructions on the screen.

The following Screen will display if the unit cannot be stabilized.

If the Syclone detector fails Stabilization, the unit cannot be used, Call Service, see Appendix Z for information.

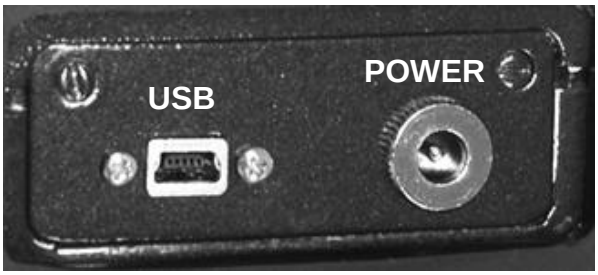
STABILIZATION OFF. NO ID!

If Stabilization is OFF, the unit still has the ability to collect samples, but with NO NUCLIDE ID.

2.6 CONNECTIONS

USB (COM) Connection: A special cable is supplied with the unit in order to connect the Syclone to a PC and transfer data for analysis.

Power Connection: The power cable/battery charger is connected to the power connector on the Syclone, which supplies 12VDC to the unit from a standard wall receptacle. A power supply and cable comes with the Syclone and is used with the integrated internal charger to charge the battery in 4 hrs.



3.0 AUTOMATIC MODE OPERATION

The **Automatic Mode** delivers a two step operation:

- **SEARCH** (see Section 3.3.1) – automatically begins when the Syclone is turned ON.
- **IDENTIFY** (see Section 3.3.2) – the user chooses the Identify function using the joystick and the Navigation Menu (see Section 3.2). Once the pre-selected sampling time is complete the Syclone will automatically analyze the sample and return a result (see Section 3.3.3).

Note: The Syclone is operated in **SIMPLIFIED** Mode when the user requires rapid detection of gamma emitting radioactive sources. Identify will automatically begin when a source is detected. The **AUTOMATIC** Mode is used when the User requires more investigation and analysis. If the customer requires changes to the operating parameters, a qualified user can set the Syclone to MANUAL Mode (see Section 2-3) and change the operating parameter(s) to suit the users' application(s). The system is then returned to the **SIMPLIFIED** or **AUTOMATIC** Mode of Operation for the User.

A typical Screening Test can be performed as follows:

1. Start the Syclone in **AUTOMATIC** Mode, the Syclone will begin the **SEARCH.**
2. Verify the Syclone responds to radiation by placing the Syclone in front of the Cs-137 source (usually 0.25 uCi Cs-137 provided with the unit).
3. The Syclone should detect the radiation and emit an audio tone. Click down on the joystick to select the **IDENTIFY** function and to collect a sample.
4. After the sample time is complete the system automatically analyzes the data to determine the isotope of the source material. (The isotope should be Cs-137).

EYES FREE Audio Warning System:

For Eyes Free operation the unit emits a loud variable pitch audio tone proportional to the intensity of the gamma radiation detected.

Note: The audio warning can be adjusted and/or switched off if required.

3.1 JOYSTICK – NAVIGATION MENUS

Operation of the joystick, detailing all of its functions is discussed in Section 2.1.

Navigation menus have been embedded into the system screens of the Automatic Mode (ONLY) for the following operations:

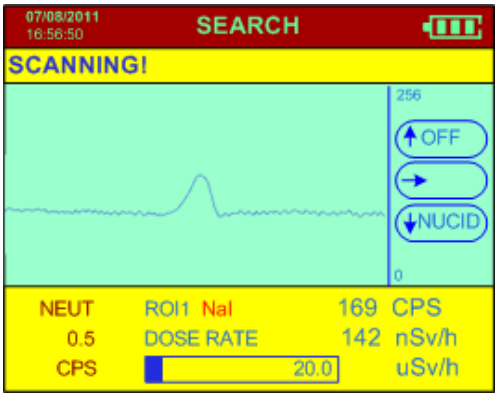
SEARCH: OFF → NUCID

IDENTIFY: OFF → STOP

NUCLIDE IDENT: OFF → 2MIN SRCH

The Navigation Menus are located on the right for the SEARCH function and across the bottom of the screens in the Identify and Nuclide Identify with the joystick functions described below:

SEARCH (Navigation Menu):

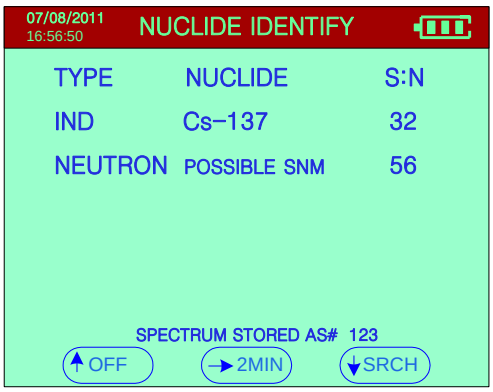


- **no action**
- **OFF** – approx. 4 secs then unit powers OFF
- **NUCID** – switches to the IDENTIFY and NUCLIDE IDENTIFY functions

IDENTIFY (Navigation Menu):

- **no action**
- **OFF** – approx. 4 secs then unit powers OFF
- **STOP** – stops the IDENTIFY sample

NUCLIDE IDENTIFY (Navigation Menu):

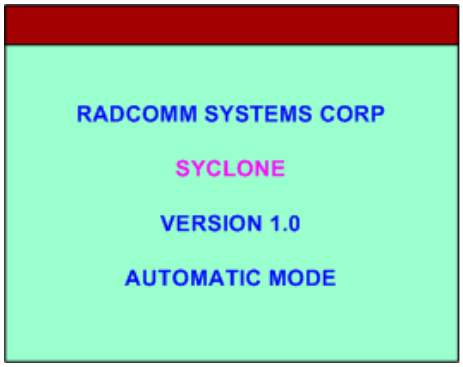


- **2MIN –** initiates an additional 2 minute count that adds to the current spectrum and at the end of the period gives a combined analysis
- **OFF** – approx. 4 secs then unit powers OFF
- **SRCH –** switches to the SEARCH

Left click toggles between S:N and H.L(half life).

3.2 STARTUP DISPLAYS

Pull the joystick down to turn the unit **ON** and various displays are seen:

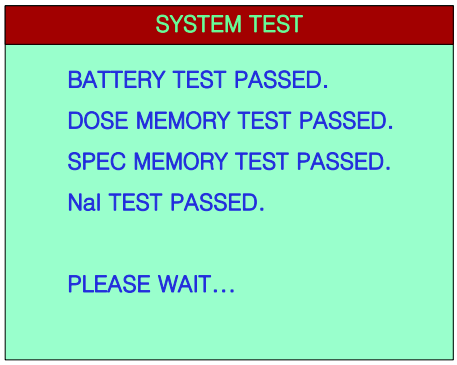


a) STARTUP – this display appears for only a few seconds (see Figure). Data shown as follows:

SYCLONE – instrument name

VERSION 1.0 – the firmware version in the unit

AUTOMATIC MODE ACTIVE – shows the unit is in the **AUTOMATIC** Mode of operation



b) Initialization and Testing

After the system is turned on, system Initialization will proceed for a few seconds. The unit is carrying out internal testing to verify that components are functioning correctly. If errors are found, an audio beep will be heard.

3.3 SYSTEM USE – AUTOMATIC MODE

The Syclone in the **AUTOMATIC** Mode operates in 2 functions – **SEARCH and IDENTIFY**:

SEARCH is used to search and locate radioactive material in vehicles, packages or on people etc. The user can easily scan the suspect item and look for a significant increase in radiation using the tools described in the **SEARCH** section below.

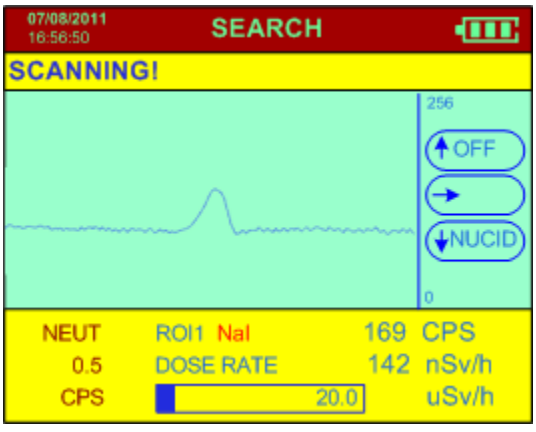
Once a radiation source is detected, **SEARCH** is used to find the location of the radioactive source and then **IDENTIFY** could be used to analyze the sample and determine the isotope.

Note: When radioactivity is detected, the Syclone emits an audio tone that rises in pitch the closer it gets to the source, allowing the user to locate the source quickly.

As described in detail (see Section 3.4.2), **IDENTIFY** collects a spectrum (default acquisition time 55 seconds) then automatically analyses it and advises the user of the details of any radioactive material(s) found.

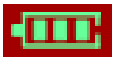
3.3.1 SEARCH

This function is used to search for radioactive material(s). When the unit is turned ON in the **AUTOMATIC Mode** and the display shows the **SEARCH** display (see Figure).



SEARCH display:

SEARCH – the function currently activated (i.e. SEARCH)

 - battery icon displaying battery status.

Note: The information shown below documents examples taken from the figure above. The Syclone has threshold settings for Dose Rate, Counts per Second (CPS), and Neutrons. "CPS Threshold" by default is OFF, in accordance with parameters (see Appendix C).

NEUT – shows that measurement is for Neutrons. The example shows 0.5 CPS (Counts per Second of neutrons detected).

ROI 1 NaI – This is the Region of Interest (1) collected by the sodium iodide (NaI) detector.

169 CPS – this is the gamma radiation level in cps (counts per second). This level will always show some counts even if no apparent radioactive material is present as this is the local radiation background of an area. Typically in low background areas, 50-100cps are common. Resettable **CPS radiation alarm** thresholds are: OFF, 100, 200, 250, 300, 350, 400, 450, 500, 600, 700, 1K, 2K, 5K, 9Kcps.

DOSE RATE – the bar display and the numeric data show the Dose Rate data in the selected units. The numeric data shown above (**169cps** in the figure) is an essential tool to locate radioactive material but the **DOSE** data gives the user an idea of the potential hazard level of such material.

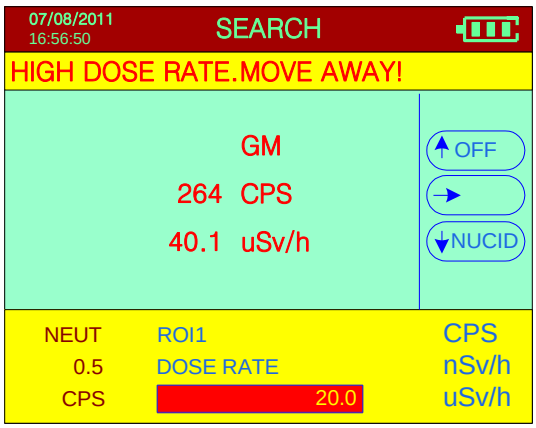
142 nSv/h – this is the current dose rate.

CHART DISPLAY – this is a chart recorder display of the radiation data. The bottom of the chart is **ZERO cps** and the top of the scale (depends upon the scale setting). The display moves from left to right so the **LEFT** hand data is the current data. The chart shows the last 256 samples and is a very useful "view back" at the data making it very easy to see any significant radiation increases. Note that the numeric **cps** data is not energy dependent so very small changes of any type of radioactive material emitting gamma rays can be easily seen.

– the bar graph gives the user an easy visual display of the Dose rate level (Zero on the left and Maximum on the right). The Maximum Dose level allowed is determined by the Users' technical personnel. This level is then reflected in the system parameters and defines the high radiation threshold for the bar graph. The User is warned when the limit is exceeded – see the HIGH DOSE Section 3.3.1.1.

20.0 - this shows the defined limit selected by the system supervisor that is the maximum range on the bar graph. If this limit is exceeded a special alarm occurs. Note that this user is in the units selected – in the display shown – since the D.RATE is in µSv/h then the 20.0 = 20.0µSv/h. At this setting, if the DOSE RATE exceeds 20.0 µSv/h then the warning alarm will occur (see Section 3.3.1.1). Resettable **Dose Rate radiation alarm** thresholds are: OFF, 10, 20, 50, 100, 200, 500, 1000, 2000, 4000, 5000, 9000 µR/h (linked to units).

Note: If the radiation goes above the maximum dose level, a high dose warning is displayed on the screen and a high pitched sound is emitted.



3.3.1.1 HIGH DOSE

The system has a preset maximum Dose Rate level – normally set at 10**µSv/h (1000µR/h)**. Below this level Dose Rates are considered acceptable for system operation. However above this level it is recommended that users move away from the source of radiation to reduce the high Dose Rate to an acceptable level. To make things simple, the **Syclone** advises the users automatically if the Dose Rate goes above the

preset limit, "**HIGH DOSE RATE. MOVE AWAY!**"

If the level is exceeded a **distinctive** audio warning tone occurs and the display changes.

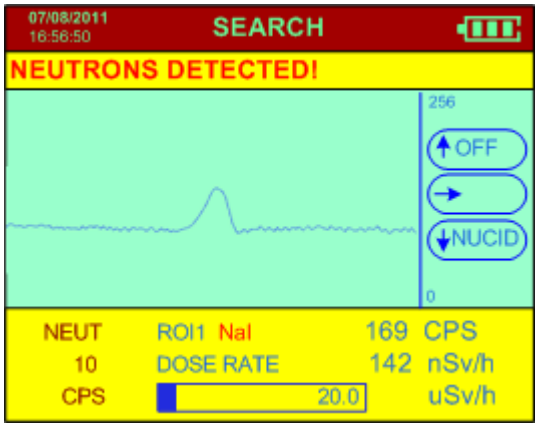
As noted the user should back away until the Dose Rate level falls below this limit and the display warning goes away.

Note that the lower Dose Rate bar graph also shows that the Dose rate is at or above the preset limit. Users should be reminded that short-term operation close to the limit has a negligible hazard level but prolonged operation significantly above this level is not recommended.

If the dose rate exceeds 40**µSv/h,** the unit automatically switches the dose rate measurement from NaI crystal to GM tube.

3.3.1.2 NEUTRON ALARM

If the integrated Neutron detector detects neutrons above the preset alarm threshold then a Neutron Alarm is declared **(NEUTRONS DETECTED!)**. A distinctive audio warning tone occurs and the display shows neutron warning (see Figure).



3.3.2 IDENTIFY

Once the location of the source is detected the user can attempt to identify the type of source by switching to the IDENTIFY function. The IDENTIFY function is activated by pressing **ENTER**, displaying a new screen:

Note: To obtain good results, position the Syclone at the highest point of radioactivity found by the SEARCH function. Keep the Syclone as stable as possible during sampling to get a good result.

IDENTIFY display (Information Line):

SCANNING! – the function currently activated.

IDENTIFY IS IN PROGRESS – advises the user that a sample is in progress for the time period set in the unit so the unit should be held in a fixed position to enable a proper sample to be taken.

Alternative displays in information line are:

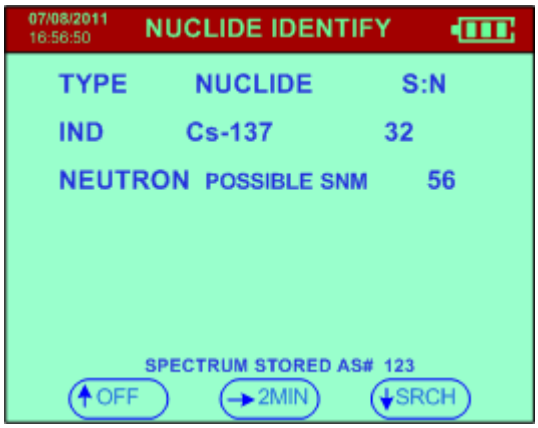
MOVE CLOSER – means that the signal is very weak so **if possible** the user should move the unit **closer** to the suspect source of radiation. In many cases this is impossible so no action need be taken, but if possible move the unit closer until the display shows **OK**.

MOVE AWAY – means that the signal is stronger than is necessary to take a proper sample. Correct action is to back away until the display shows **SCANNING!**

TIME – This shows the time already used for collecting the spectrum. In this case, it is 7s. If the acquisition time is 2 minutes, then the progress bar shows the progress of the 2-minute count time.

The progress box shows the time progress to the end of the sample period.

3.3.3 RESULTS



After the sample time is complete the system automatically analyses the data to determine the isotope of the material and displays the results as shown (see Figure).

Note: When the NUCLIDE IDENTIFY result is displayed, the audio beeps(depends on the setting) to remind the user that the result is ready.

NUCLIDE IDENTIFY display:

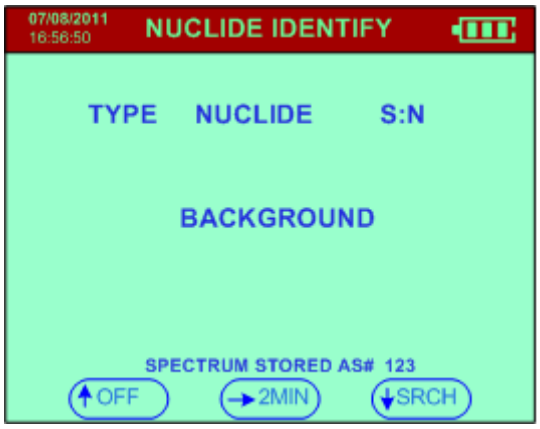
TYPE – shows the category of the isotope identified.

Labels used are:

- **IND** – Industrial isotope
- **MED** – Medical isotope
- **SNM** – Special Nuclear Material
- **NORM** – Naturally Occurring Radioactive Materials

ISOTOPE – is the actual name of the isotope (see Appendix B).

SPECTRUM STORED AS #(x) - every time an IDENTIFY analysis takes place the radiation data (spectrum) from this analysis is stored in memory where it can be accessed with special software for subsequent analysis as required. "**Spectrum stored as #(x)**" is shown at the lower part of the screen (where x is a sequential number) to advise the user that the spectra is being saved in memory as SPECTRUM #(x) for future retrieval. This number (x) can be anywhere from 1 to 498 and serves to uniquely identify the data in system memory for use during data retrieval and analysis. It is important to keep accurate records of the spectra origin to link the spectra to a particular source or event.



UNKNOWN SOURCE – (and Shielded Source) The Syclone has a wide selection of radioactive isotopes in its internal library. If after analysis, the isotope or the residual signal/ gamma peak cannot be identified, and the **Dose Rate ≤ Base Dose Threshold** the screen displays "**UNKNOWN SOURCE**".

If the analysis results are such that the **Dose Rate ≤ Base Dose Threshold** radiation, and no gamma-peaks found then the Syclone shall display "**BACKGROUND**" as the system is seeing the local background.

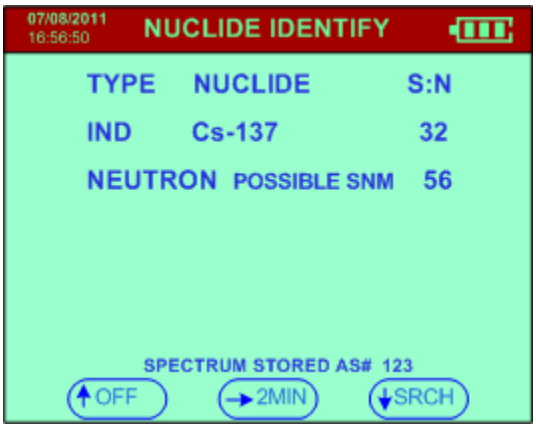
Furthermore, the results may contain peaks with no Isotope Identification, scattered radiation with no Isotope Identification, or a combination of an identified isotope and

strong peaks with no Isotope Identification and if the **Dose Rate > Base Dose Threshold**. These all may indicate the presence of an **SHIELDED SOURCE**.

Note: If the isotope cannot be identified, retrieve the stored spectrum and follow your predefined operating protocol, or call the **RadComm Help desk** (see Appendix Z) who will direct the call to the appropriate person for further analysis.

NEUTRONS DETECTED DURING IDENTIFY

The presence of neutrons may indicate special nuclear material, as the SNM may be associated with neutron emission. If any neutron activity is detected and it is above the preset threshold during **IDENTIFY** analysis, the **NUCLIDE IDENTIFY** screen will display **"POSSIBLE SNM"** – (see Figure).

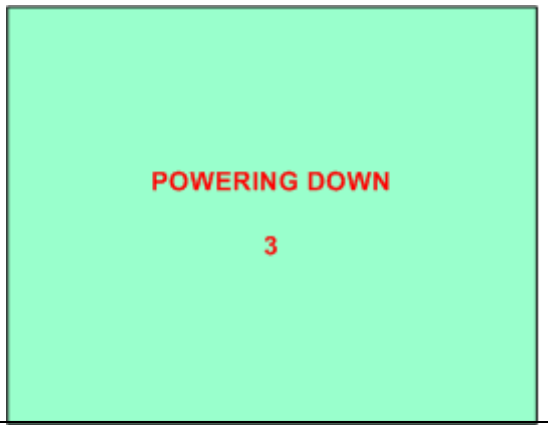


The unit is more sensitive to neutron radiation in the **IDENTIFY** function, because it collects samples for a longer period of time (55 seconds) as opposed to the **SEARCH** function. A weak neutron source has a better chance to be detected using **IDENTIFY**, when it is missed in **SEARCH**.

OTHER FEATURES:

3.4 POWER OFF - MANUAL

CLICK **UP** (away from the user) and hold for 4 seconds (see Figure). The display will show a special display (see Figure) with the seconds counting down; **3, 2, 1**. After this countdown the unit powers **OFF**. At any time during the countdown, releasing the JOYSTICK will cancel the power OFF.



3.5 BACKLITE

The BACKLITE function is built into the Syclone so that the display may be viewed in low ambient light conditions. BACKLITE is enabled for constant use.

3.6 CALIBRATION REQUIRED

The Syclone spectrometer is a finely tuned instrument that provides accurate results when all components are functioning properly. In order for the Syclone to maintain its high level of accuracy, the instrument should be calibrated by a certified company every 12 to 18 months. The Syclone will show the message "CALIBRATION REQUIRED" which is informing the operator that the Syclone should be calibrated.

4.0 SIMPLIFIED MODE OPERATION

The **SIMPLIFIED Mode** delivers a one-step operation:

SEARCH + Identify: – automatically begins when the Syclone is turned ON.

A typical Screening Test can be performed as follows:

1. Start the Syclone in SIMPLIFIED Mode, the Syclone will begin the **SEARCH.**
2. Verify the Syclone responds to radiation by placing the Syclone in front of the Cs-137 source (usually 0.25 uCi Cs-137 provided with the unit).
3. The Syclone should detect the radiation and emit an audio tone and automatically switches to the **SPECTRUM ANALYSIS** screen showing the sample time.
4. After the sample time is complete the system automatically analyzes the data to determine the isotope of the source material. (The isotope should be Cs-137).

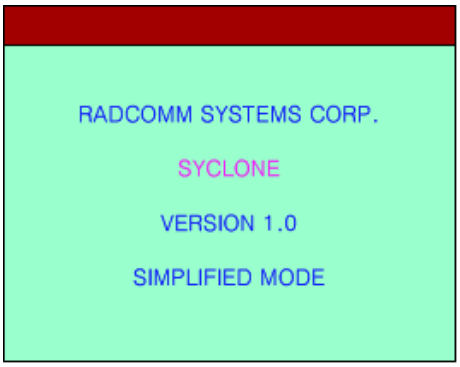
EYES FREE Audio Warning System:

For Eyes Free operation the unit emits a loud variable pitch audio tone proportional to the intensity of the gamma radiation detected.

Note: The audio warning can be adjusted and/or switched off if required.

4.1 STARTUP DISPLAYS

Pull the joystick down to turn the unit **ON** and various displays are seen:



a) STARTUP – this display appears for only a few seconds (see Figure). Data shown as follows:

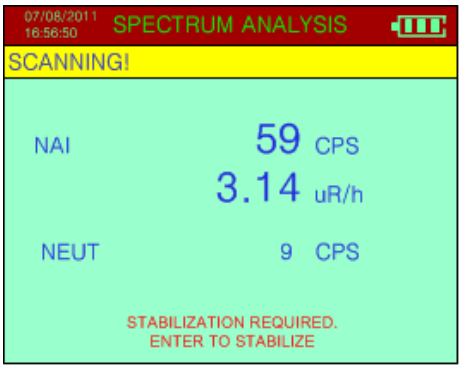
SYCLONE – instrument name

VERSION 1.0 – the software version in the unit

SIMPLIFIED MODE ACTIVE – shows the unit is in the **SIMPLIFIED** Mode of operation

b) STABILIZE

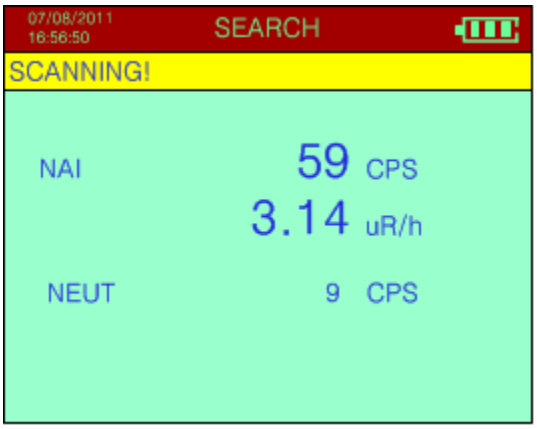
If the Syclone requires stabilization, this screen will be displayed.

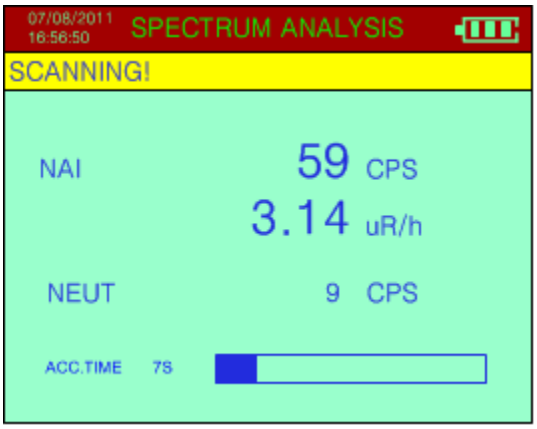


Pressing **Enter** will open the STABILIZE Screen.

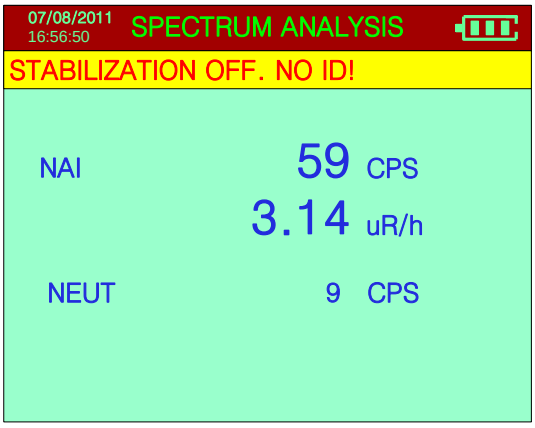
4.2 SYSTEM USE – SIMPLIFIED MODE

This Syclone automatically begins the **SEARCH** function, scanning for radioactive material(s). (see Figure)

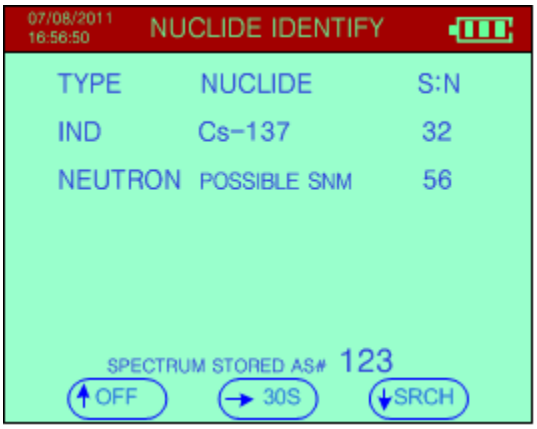




When the unit **FINDS** a source it automatically switches to the **SPECTRUM ANALYSIS** function and the display shows Sample Time (see Figure). The audio will beep and the unit will vibrate. Right clicking the joystick will disable the audio and vibration to save the battery power. If the Stab Mode is set to OFF, the following screen will be shown.



After the sample time is complete the system automatically analyses the data to determine the isotope of the source material(s). The **NUCLIDE IDENTIFY** screen opens automatically, showing the result.



At this point the User can resume the Search function by pressing the joystick in the correct direction (see below). See Section 2.1 for Joystick details.

30S – initiates an additional 30 second count that adds to the current spectrum and at the end of the period gives a combined analysis

OFF – approx. 4 secs then unit powers OFF

SRCH – initiates a new SEARCH

Left click toggles between S:N and H.L(half life).

Note: Samples are saved to the Syclone memory each time a spectra is found, to be later uploaded to a PC using the USB cable provided.

5.0 SYCLONE SPECIFICATIONS

Note: *System Specifications are subject to change without notice.*

DETECTORS

GAMMA Detector

a) Gamma NaI – Size 1.5" (38mm) x 2" (51mm).
   Energy Resolution 7.0% or better for 662 KeV
b) Geiger Mueller – Size 0.59" (15mm) x 1.9" (49mm)

Stabilization: Cs-137 source <3 mins

DOSEMETER

Accumulate dose up to 10 Sv

Span time: 1, 2, 3, ... , 10, 20, 30, ... , 60s

Measurement Units: Selectable – R, Sv, Gy

Energy Range: 20keV – 3.0MeV

Dose Range: NaI Detector: 0μR/h – 4mR/h (0nSv/h – 40μSv/h)
GM Detector: 4mR/h – 1R/h (40μSv/h – 10mSv/h) calibrated
Extended Range: 1R/h – 10R/h (10mSv/h – 100mSv/h) verified

Note: NaI detector may overload at higher levels at a different rate depending on the isotope. Approximate maximum levels are 2mR/h for Am-241 and 5mR/h for Cs-137.

NUCLIDE LIBRARIES

Pre-defined: Standard and Medical (Industrial libraries will be available soon)

CLOCK - CALENDAR

Type: Built in 24-hour clock, 99-year calendar (including leap year).
Full battery backup, 10 year retention time

Precision: +/- 3 s/day at 25^{o}C
+/- 30 s/day over full operating temperature range

DATA STORAGE

Type: Flash memory.

Capacity: 100,000 dose rate samples / 498 Spectra

Stored Data Retrieval: Via USB to a PC.

DATA OUTPUT

Type: USB.

Format: Binary data in packets

USER INTERFACE

Control: Single Multifunction Joystick (All functions and features)
Display Type: TFT Color LCD,
QVGA (320 x 240 resolution)
Display Viewing Area: 3.5” Diagonal
Menus/Screens: English, Chinese, Japanese, Spanish, German

POWER

Adapter Voltage: 12VDC (Range 7 – 30 VDC)
Consumption: Measurement – 2.73W
Internal Source: Rechargeable Batteries – Manufacturers’ Lithium Battery
Capacity: 4800mAh, 3.7V
Operating Time: Rechargeable batteries – around 7 hours
Battery Charging: typically 4 hours, full charge indication by Battery Icon

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CONNECTORS

External Power Supply: 2.5mm power circular jack, "+" on the center pin.
Mating connector: 2.5mm power circular plug

COMM Port: mini USB.

PHYSICAL

Dimensions: Length – 7.75" (197mm)
Width – 3.5" (89mm)
Height - 3" (76mm), 5.59" (142mm) including handle

Weight: 1.7 kg (3.7lbs) including batteries

ENVIRONMENTAL

Operating Temperature Range: -4°F to 140°F (-20°C to +60°C)
Storage Temperature Range: -4°F to 140°F (-20°C to +60°C)
Protection: Weatherproof, dust sealed, water splash-proof
Relative Humidity: 93% non-condensing at 104°F (40°C)
Vibration: 2 g for 15 min at 10 – 33 Hz in XYZ directions (ANSI N42.34)
Shock: Complies with ANSI N42.34
EM Compatibility: ANSI N42.34 compliant
CE compliant (EU safety, RFI and EMI directives)
FCC CFR 47, Part 15, Subpart B, Class B compliant

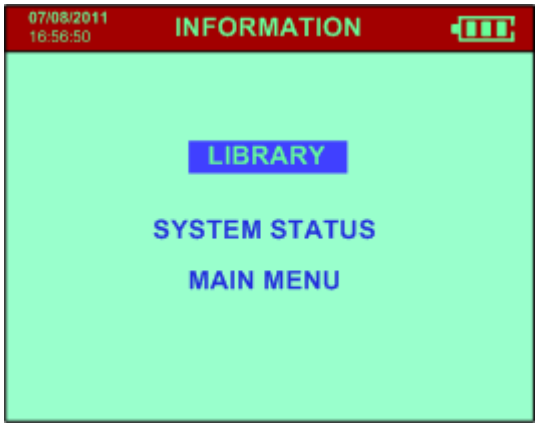
ACCESSORIES

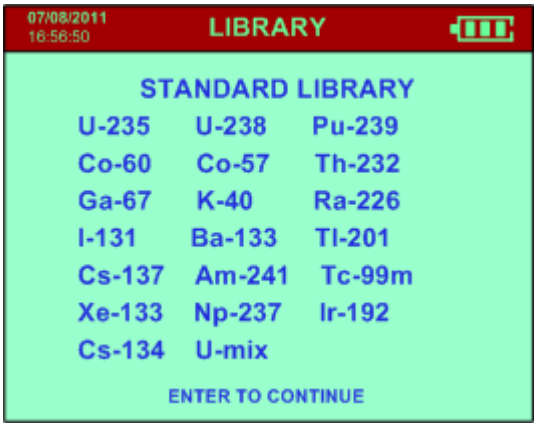
Standard:
- Vinyl Transportation Case
- USB Communication Cable
- Cs137 0.25µCi Test Source
- 12 VDC universal AC/DC Power Adaptor
- System Operation Manual
- Certificate of Calibration
- CD-ROM with Syclone PC Software
- Protective rubber boot

APPENDIX A – USING ISOTOPE LIBRARIES

While the STANDARD library is the default library when Syclone PC Software is installed, other libraries can be used to analyze the spectra downloaded from the Syclone. This enables the user to re-analyze the spectra with the same library as used in the Syclone, or with a different library, thus providing an additional tool in assessing unknown spectral features.

The standard library used with the **Syclone unit** is as shown below. This is the library used to determine the nuclide identification and provide samples in the **IDENTIFY** function.





Please note that when the Syclone PC Software is opened, it will always load the last library used. The Standard library is the same as used in the Syclone unit. If a different library is required, it must be loaded to the Syclone PC Software application from a file.

APPENDIX B – NUCLIDE LIBRARIES

The current list of nuclides in the Standard Library are:		Type of Isotope
Name	**Label**	
Am-241	Americium-241	I
Ba-133	Barium-133	I
Co-57	Cobalt-57	I
Co-60	Cobalt-60	I
Cs-134	Cesium-134	I
Cs-137	Cesium-137	I
Ga-67	Gallium-67	M
I-131	Iodine-131	M
Ir-192	Iridium-192	I
K-40	Potassium-40	N
Np-237	Neptunium-237	S
Pu-239	Plutonium-239	S
Ra-226	Radium-226	N
Tc-99m	Technetium-99m	M
Th-232	Thorium-232	N
Tl-201	Thallium-201	M
U-MIX	Uranium-MIX	N
U-235	Uranium-235	S
U-238	Uranium-238	N
Xe-133	Xenon-133	M

The current list of nuclides in the Medical library are:		Type of Isotope
Name	**Label**	
Au-198	Gold-198	M
Cr-51	Cromium-51	M
Cs-134	Cesium-134	I
Ga-67	Gallium-67	M
I-123	Iodine-123	M
I-125	Iodine-125	M
I-131	Iodine-131	M
In-111	Indium-111	M
Ir-192	Iridium-192	I
K-40	Potassium-40	N
Ra-226	Radium-226	N
Sn-113	Tin-113	M
Tc-99m	Technetium-99m	M
Th-232	Thorium-232	N
Tl-201	Thallium-201	M
U-235	Uranium-235	S
U-238	Uranium-238	N
V-48	Vanadium-48	M
W-188	Tungsten-188	M

Note: Currently RadComm has no plans to permit users to modify the libraries as library development is so complex that modifications can easily unbalance the analysis capability of the system and significantly degrade its' performance. However we will readily work with users to develop an appropriate library to fulfill their special requirements.

Labels in columns

I= Industrial, M=Medical, S=SNM, N=NORM

APPENDIX C – RECOMMENDED PARAMETERS

SETUP	PARAMETER	DEFAULT	SELECTION
MENU			
SEARCH	DATA TRANSFER	OFF	OFF, MEM, PC
	SPAN TIME	1	1, 2,3 -10, 20,30-60 secs
	GRAPH SCALE	AUTO	AUTO, 64, 128, 256, 512, 1K, 2K, 4K, 8K, 16K, 32K, 64K,128K,256K,512K , 1M, 2M, 4M, 8M, 16M, 32M, 64M,128M,256M, 512M, 1G, 2G, 4G cps
	AUDIO SCALER	AUTO	OFF, AUTO, 50, 100, 150, 200, 250cps
	ALARM THRESHOLD	OFF	OFF, 100, 200, 250, 300, 350, 400, 450, 500, 600, 700, 1K, 2K, 5K, 9Kcps
	SELECT ROI	TOTAL	TOTAL, ROI1, ROI2, ROI3, ROI4
	AVERAGING	3P	OFF, 3P, 5P, 10P
STABILIZE	STAB MODE	24H	OFF, 12H, 24H, AUTO
	ISOTOPE	Cs-137	
IDENTIFY			
DETECTOR	DETECTOR	NaI	NaI
	PILEUP	ON	ON, OFF
	PEAK THRESHOLD	3.0	2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0
	BASE DOSE THRES	20	10, 15, 20, 30, 40, 50 (µR/h units)
	NUCLIDE THRES	7	3, 5, 7, 8, 9, 10, 11, 12, 15 (SD units)
NaI	MEASURING TIME	55	10-50, 55,60-100, 200-600, 1200, 1800, 3600, 5400secs
	MEASURING MODE	CLOCK	LIVE, CLOCK, REP.
	AUDIO ALERT	ON	ON, OFF
	ALARM THRESHOLD	3	OFF, 1,2 -10, 20, 50, 100
NEUTRON	SPAN TIME	1	1, 2 - 10, 15, 20, 50, 100
DOSE	UNIT	SV	R, SV, GY
	SPAN TIME	1	1, 2-10, 20-60secs
	AVERAGING	3P	OFF, 3P, 5P, 10P
	ALARM THRESHOLD	50	OFF, 10, 20, 50, 100, 200, 500, 1000, 2000, 4000, 5000, 9000 µR/h (LINKED TO Units)
ROIs	ROI#1	15-30	0–1023 to 0–1023 (Am-241)
	ROI#2	210-230	0–1023 to 0–1023 (Cs-137)
	ROI#3	320-470	0–1023 to 0–1023 (Co-60)
	ROI#4	840-900	0–1023 to 0–1023(Th-232)
MISC - ELLANEOUS	AaBbCc-LANGUAGE	ENGLISH	ENGLISH, Chinese, Japanese, Spanish, German
	BATTERY	Lithium	Lithium
	ACTIVE LIB	STANDARD	STANDARD, MEDICAL,USER
	LCD MODE	NIGHT	DAY,NIGHT

APPENDIX D – QUICK START – AUTOMATIC MODE

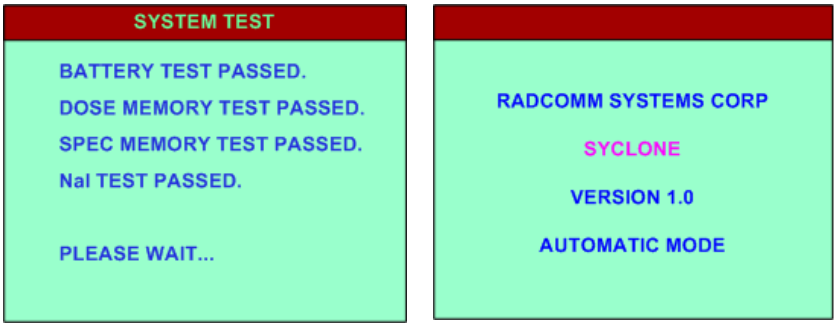
The **Syclone** automatically turns on when the joystick is pulled down. A (0.25µCi (9.25kBq)) Cs-137 stabilization source is supplied with the unit and is used as directed when the unit requires stabilization.

Note: The **Syclone** is limited to two active functions when set to the **AUTOMATIC MODE** of Operation: **SEARCH** and **IDENTIFY**.

The steps below illustrate the process involved:

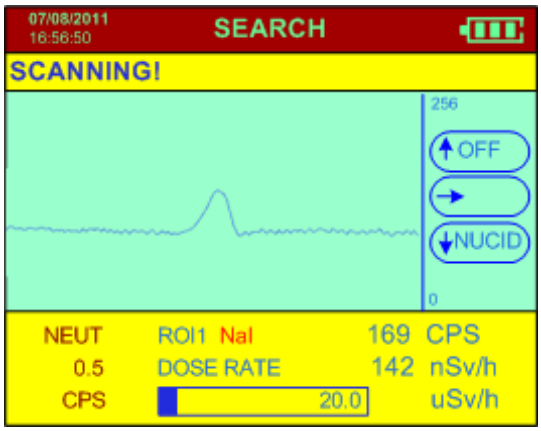
Note: If batteries are not loaded see Section 1.5 and Figure **para g & h** to properly load batteries.

1. The Syclone detector is shipped ready to use. The Syclone is also shipped in **MANUAL MODE**, to facilitate the setup of the detectors parameters by the customers' technician. This will allow the customer to setup the detector to their specific needs. The technician should set the detector to **AUTOMATIC MODE** prior to giving it to the operator.



At startup these screens only appear briefly before an Intro Screen appears. The Active Mode is displayed across the bottom of the Introduction screen (ie. **AUTOMATIC MODE**).

2. The **SEARCH** function of operation:



a. The User sweeps the area in a slow steady manner listening for an audio tone and when practical glancing at the display for evidence of a source. The system display will show the current count rate in counts/sec while the internal "audio meter" will give an audio response with the tone related to radiation intensity.

b. When radioactivity is detected, the Syclone emits an audio tone that rises in pitch the closer it gets to the source.

c. When the user finds the location of the source (peak of the audio tone) **IDENTIFY** is selected by (**short click**) down with the joystick to analyze a spectrum sample.

3. The **IDENTIFY** function of operation (see **Figure G-1**):

IDENTIFY takes a spectrum sample for a user defined sample time (default 55s) as follows:

a. To get a good sample, position the Syclone at the highest point of radioactivity found by **SEARCH**, or follow the **MOVE CLOSER /MOVE AWAY** instructions.

b. Keep the Syclone as stable as possible during sampling to get a good result.

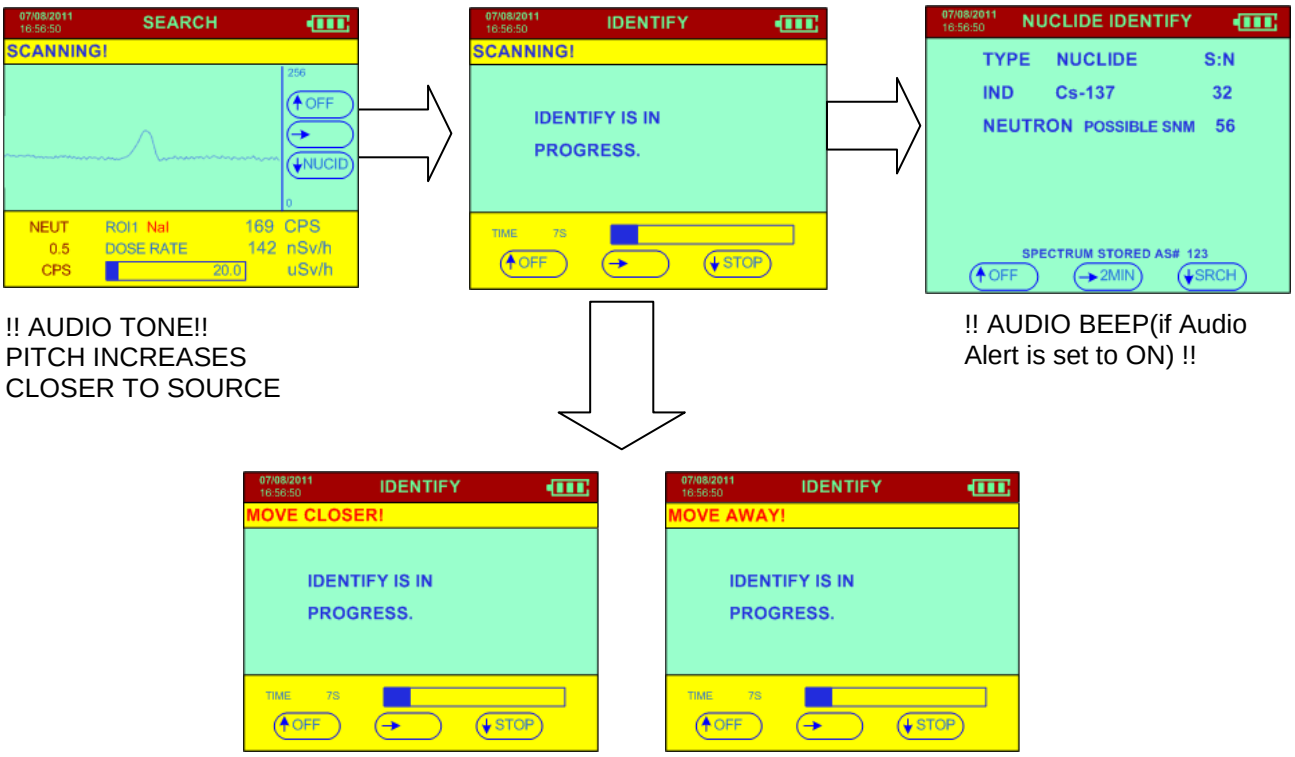
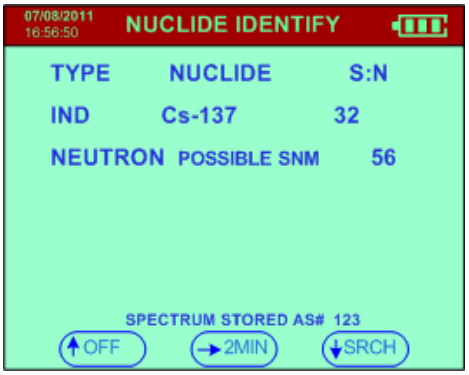


Figure G-1



c. After the sample time is complete the system automatically analyzes the data to determine the Isotope and displays the results in the NUCLIDE IDENTIFY screen.

d. When the **NUCLIDE IDENT** Result (see **Figure G-1**) is displayed, the audio beeps(if Audio Alert is set to ON) to remind the user that the data result is ready.

e. Once the Spectrum is analyzed, the user will use the joystick with a short click down to begin another **SEARCH** session.

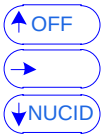
f. Prior to beginning the next search the Spectrum is automatically stored as a # in chronological order.

Note: The spectrum can be recalled from data memory and re-analyzed at a later time.

NAVIGATION MENUS

Navigation Menus have been embedded in the system screens (Automatic Mode only).

SEARCH:



IDENTIFY:

NUCLIDE IDENT:

The Navigation Menus are located on the right for the SEARCH function and across the bottom of the screens in the Assay Mode and Assay Results with the joystick functions described below:

Note: In some screens the internal computer is busy so a few seconds may pass before the selected change occurs

SEARCH (Navigation Menu):

- **no action**
- **OFF** – approx. 4 secs then unit powers OFF
- **NUCID** – switches to the IDENTIFY and Nuclide IDENTIFY

IDENTIFY (Navigation Menu):

- **no action**
- **OFF** – approx. 4 secs then unit powers OFF
- **STOP** – stops the IDENTIFY sample

NUCLIDE IDENT (Navigation Menu):

- **2MIN –** initiates an additional 2 minute count that adds to the current spectrum and at the end of the period gives a combined analysis
- **OFF** – approx. 4 secs then unit powers OFF
- **SRCH –** switches to SEARCH

Refer to Chapter 3.0 for a detailed explanation of all the screens and menus.

APPENDIX E – SAFE HANDLING OF CHECK SOURCES

External Check Sources:

- **Licensing Requirements**: Radioactive material contained in this device is exempt from USNRC or US Agreement State licensing requirements. It is also exempt in most countries around the world. However in all cases it is a controlled substance. Users should make themselves familiar with local regulations to ensure compliance.

- **Safe Handling**: Although quantities of radioactive material contained in these products are extremely small, the basic radiation protection principles of time, distance and shielding (ALARA – As Low As Reasonably Achievable) should be practiced as effective methods for minimizing exposure.

- **Use**: These devices should only be used as a method for verifying response of radiation measuring devices, and are to be used in accordance with manufacture's instructions. These sources are not for human use, introduction into foods, beverages, cosmetics, drugs or medicines, or into products manufactured for commercial distribution. Exempt quantities should not be combined to increase the source activity.

- **Storage**: All devices containing radioactive material should be securely stored when not in use. Any loss of radioactive material must be reported to the local authorities.

- **Disposal**: There are several ways to dispose of radioactive materials. The user is advised to check local regulations and dispose the radioactive material according to these regulations.

APPENDIX Z – WARRANTY

RadComm WARRANTY

RadComm warrants the product to be free of defects in material and workmanship for a period of one year from the date of purchase. The warranty does not cover consumables or damage caused by improper use or unauthorized repairs.
For details concerning warranty terms refer to the "*Standard Terms and Conditions*" as referenced in your purchasing agreement.

To make a warranty claim, contact the RadComm Help Desk at:

Contact: **Help Desk**
24 Hour Product Support

Phone: **1 – 905 – 829-8290 ext 3**

Fax: **1 – 905 – 829-1406**

Email: **inquiries@radcommsystems.com**